Long-Term Variable Milfoil Management and Control Plan for SALMON MEADOW AND ASH COVE (KRAINWOOD SHORES) LAKE WINNIPESAUKEE
Gilford, New Hampshire
Belknap County

Prepared by: New Hampshire Department of Environmental Services (DES),
in consultation with the
New Hampshire Fish and Game Department (F&G)
February 2007

PROBLEM STATEMENT

Exotic aquatic plants pose a threat to the ecological, aesthetic, recreational, and economic values of lakes and ponds (Luken & Thieret, 1997, Halstead, 2000). According to the 2006 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM), "exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Such infestations are in violation of Env-Ws 1703.19, which states that surface waters shall support and maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region" (DES, 2006).

Though exotic aquatic plants can negatively impact an aquatic system, native aquatic plants are beneficial to the aquatic ecology of waterbodies. Diverse assemblages of native aquatic plants are a source of oxygen to the system, they provide stabilizing root systems to minimize erosion and turbidity, and they provide food and habitat for aquatic life.

Variable milfoil became established in Lake Winnipesaukee in the late 1960s. It is currently found in dense patches around most of the shoreline areas of the cove. Figure 1 summarizes the locations of infestations in Salmon Meadow and Ash Cove of Krainwood Shores Community (note that Area 1 on the map refers to an infestation at Black Cat Island, and will not be discussed here):

Area 2- This area, which is approximately 2.3 acres, has 85% variable milfoil cover starting at depths of 3 feet to depths of about 7 feet in the area designated in Figure 7. There is a small stand of cattails growing along the shore with bur-reed and pondweed scattered throughout the cove. The bottom composition here is mainly muck.

Area 3- This area, which is approximately 5 acres, has variable milfoil cover that is present at 15%, which is mixed with native vegetation including pondweeds, bladderwort, bur-reed and sterile thread-like bottom growth. The bottom composition here is mainly muck, with some small areas of sandier substrate.

Area 4- This area is 2.5 acres, and has variable milfoil densities of 10%, with pondweeds and pipewort. Muck bottom.

Area 5- This area is 2.0 acres, and has variable milfoil densities of 5% with bladderwort, yellow water-lilies, pipewort and sterile thread-like bottom growth. Muck bottom.

Area 6- This area, which is about 6 acres, has dense patches of milfoil covering 70% of the cove with watershield, bur-reed, bladderwort, white water-lilies , yellow water-lilies, pondweed and pipewort scattered among the cove. Mucky bottom. There is a loon nesting area at the north end of this area.

Area 7- This 0.96 acre area has variable milfoil densities of 30%, mixed with native plants that include white water-lilies and pondweeds. Mucky bottom.

Additionally, there are scattered points of more clump-like variable milfoil growth scattered throughout the Cove. The clumps are generally 5 feet in diameter, with low percent cover.

In terms of the variable milfoil impacts to shorefront property owners, there are approximately 130 houses surrounding the Salmon Meadow and Ash Cove shoreline. There are no back lots that have lake access.

At this time, there are no data and no observable problems with the biological integrity of the aquatic community as a result of the variable milfoil infestation; however, no biological integrity surveys have been conducted as part of this plan preparation.

PURPOSE

In November 2006, the Krainwood Shores Association requested matching funds from the Department of Environmental Services to conduct an exotic aquatic plant control project during the spring of 2007.

The purposes of this exotic aquatic plant management and control plan are:

1. To identify the waterbody's beneficial use areas, including essential aquatic habitat, designated conservation zones, swimming areas, boat access sites, and boating use areas;
2. To present the aquatic macrophyte distribution map, including both native and exotic species;
3. To identify short-term and long-term exotic aquatic plant control goals that protect and conserve the lake's beneficial uses;
4. To recommend exotic plant control actions that meet the goals outlined in this plan; and
5. To recommend monitoring strategies to determine the success of the control practices over time in meeting the goals.

This plan also summarizes the current physical, biological, ecological, and chemical components of Salmon Meadow and Ash Cove, and the social and ecological impacts of the variable milfoil infestation.

The intent of this strategic plan is to control variable milfoil in Salmon Meadow and Ash Cove over time through the use of Integrated Pest Management Strategies (IPM). Appendix A details the strategies available for waterbodies with exotic species, and provides more information on each of the activities that are recommended within this plan.

GOALS/OBJECTIVES OF MILFOIL CONTROL ACTIONS

Because of the expansive size of the overall variable milfoil infestation within Lake Winnipesaukee, DES recognizes that eradication of variable milfoil in the lake system as a whole is unlikely, both due to the degree of fragmentation of the plants and subsequent spread, but also due to the overall cost of attempting a lake-wide eradication project on this lake.

For Salmon Meadow and Ash Cove, DES proposes to work with the cove association to perform variable milfoil management practices to minimize the recreational, ecological, human health, business, and aesthetic impacts caused by dense growths of this invasive plant, while maintaining the overall integrity of native plant communities whenever variable milfoil control actions are being implemented.

Specifically, the goals are as follows:

1) In 2007, reduce the overall percent of milfoil bottom growth in Area 2 of Salmon Meadow and Ash Cove from 85% cover to at least less than 10% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.

2) In 2007, reduce the overall percent of milfoil bottom growth in Area 3 of Salmon Meadow and Ash Cove from 15% cover to at least less than 5% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.

3) In 2007, reduce the overall percent of milfoil bottom growth in Area 4 of Salmon Meadow and Ash Cove from 10% cover to at least less than 5% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.

4) In 2007, reduce the overall percent of milfoil bottom growth in Area 5 of Salmon Meadow and Ash Cove from 5% cover to at least less than 1% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth. Because this area is so small and so sparsely infested overall, further reducing variable milfoil cover with herbicides will hopefully lead to successful removal of all milfoil in this are when integrated approaches are employed.

5) In 2007, reduce the overall percent of milfoil bottom growth in Area 6 of Salmon Meadow and Ash Cove from 70% cover to at least less than 10% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth.

6) In 2007, reduce the overall percent of milfoil bottom growth in Area 7 of Salmon Meadow and Ash Cove from 30% cover to at least less than 5% cover using the aquatic herbicide 2,4-D. This will allow for smaller scale control actions to take place in future years, including diver removal and benthic barrier placement to control smaller areas of regrowth. We recognize that there is a loon nesting site at the tip of this cove. If there are loons present at the beginning of the growing season, and they appear to be nesting, this site will be eliminated from the locations of herbicide treatment for this year.

7) The longer term goal is to maintain variable milfoil coverage to at or below the target levels indicated in 1-6 above. This can be done by using hand-removal, benthic barriers, and/or diver-assisted suction harvesting in summer 2007, and annually thereafter if new stems or localized patches are present. Additional herbicide applications may be done at 3-year intervals if needed to maintain the specified target percent coverages.

Town Support

The Town of Moultonborough has been supportive of the actions taken by Krainwood Shores Association to control variable milfoil. The town, at this point, has not made financial contributions to the efforts.

Krainwood Shores Association Support

There are 130 shorefront properties within the Krainwood Shores community. Everyone that is involved with this group has faced impairments as a result of the variable milfoil growth. The Association will work to put together a group of Weed Watchers and monitors to track new growth or re-growth in the cove.

WATERBODY CHARACTERISTICS

Table 1 summarizes basic physical and biological characteristics of Salmon Meadow and Ash Cove:

General Lake Information	
Area (acres)	135
Shoreline Uses (residential, forested, agriculture)	Residential, forested
Max Depth (ft)	9.9
Mean Depth (ft)	6.6
Trophic Status (of Lake Winnipesaukee)	Oligotrophic
Plant Community Information Relative to Management	
Invasive Plants (Latin name)	*Myriophyllum heterophyllum*
Infested Area (acres)	Approximately 20 acres
Distribution (ringing lake, patchy growth, etc)	Larger patches within Cove, with some scattered clumps of variable milfoil throughout
Sediment type in infested area (sand/silt/organic/rock)	Primarily muck
Rare, Threatened, or Endangered Species in Waterbody (according to NH Natural Heritage	Common Loon (*Gavia immer*) Threatened in NH

Inventory)	Purple Martin (*Progne subis*) Endangered in NH

Figure 2 shows a plant map for Salmon Meadow and Ash Cove.

BENEFICIAL (DESIGNATED) USES

In New Hampshire, beneficial (designated) uses of our waterbodies are categorized into five general areas: Aquatic Life, Fish Consumption, Recreation, Drinking Water Supply, and Wildlife (CALM).

Of these, Aquatic Life and Recreation are the two affected by the presence of exotic species like variable milfoil.

AQUATIC LIFE

The goal for aquatic life support is to provide suitable chemical and physical conditions for supporting a balanced, integrated and adaptive community of aquatic organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.

FISHERIES AND WILDLIFE

The principal fisheries of Lake Winnipesaukee include both warm and coldwater species. Coldwater species of primary interest are; landlocked Atlantic salmon, lake trout, and rainbow trout; coldwater species of less interest are lake whitefish, round whitefish (species of concern in Wildlife Action Plan), burbot, brook trout, and rainbow smelt.

Warmwater species of primary interest are; largemouth bass, smallmouth bass, white perch, yellow perch, chain pickerel, black crappie, brown bullhead, and bluegill. The bass fishery is extremely popular with anglers as numerous fishing tournaments are held on the lake each year.

Numerous warmwater species are present in littoral areas of the lake and constitute the prey fish sought by larger gamefish (warmwater). These species include; banded killifish, common shiner, common white sucker, creek chubsucker, bridle shiner (species of concern in Wildlife Action Plan), fallfish, golden shiner, pumpkinseed, redbreast sunfish, rock bass, slimy sculpin, and yellow bullhead.

The American eel, a catadromous species, reside up to 4-9 years in our inland lakes, such as Lake Winnipesaukee, where they reach sexual maturity and migrate down the rivers and outlets of our large lakes to the Atlantic Ocean.

RECREATIONAL USES AND ACCESS POINTS

Lake Winnipesaukee is used for numerous recreational activities, including boating, fishing, swimming, and water skiing by both lake residents and transient boaters.

There are several private and public boat access sites and marinas on Lake Winnipesaukee as a whole, but there is no public access site in Salmon Meadow or Ash Cove.

There are no public or designated swim areas within Salmon Meadow and Ash Cove, but there are many small private swim areas along the shoreline of the cove, mainly in front of private properties. Lake residents have expressed concern about the variable milfoil growth, citing access problems in front of their properties when they wish to use the lake for swimming or boating. Figure 3 illustrates the locations of the private swim platforms, which are also assumed to have swimming associated with areas near them.

Salmon Meadow and Ash Cove residents indicate that there are approximately 130 (or more) boats in the Cove, which equates to roughly one boat per household. Some households have more than one boat. On weekdays boating activity is low, but on weekends there are many visiting boats that bring water skiers. Larger boats enter the cove and raft along the eastern side of Salmon Meadow Cove where there is no development. In the shallow portions of the cove there have been many complaints about boaters having problems with variable milfoil becoming tangled around their propellers. Figure 4 illustrates the typical boat paths of boats in the cove.

In Figure 1, which shows the variable milfoil infestation, there are also points showing the locations of intakes and wells that were observed during the survey. Figure 5 shows various setbacks from the lake edge, and the locations of wells within that setback.

MACROPHYTE EVALUATION

The littoral zone is defined as the nearshore areas of a waterbody where sunlight penetrates to the bottom sediments. The littoral zone is typically the zone of rooted macrophyte growth in a waterbody. All areas of Salmon Meadow and Ash Cove are considered to be within the littoral zone of Lake Winnipesaukee, due to the shallow nature of the basins.

The littoral zone in the Krainewood shores section of Lake Winnipesaukee is characterized by a mix of native and non-native (variable milfoil) plant growth (Figure 2). Native species include a mix of floating plants (yellow and white water-lilies), emergent plants (bur-reed, bulrush, and cattail), and submergent plants (bladderwort, waterweed, tapegrass, and pondweed).

There are no records with the Natural Heritage Bureau of any rare, threatened, or endangered plants in this cove, or in Lake Winnipesaukee.

HISTORICAL CONTROL ACTIVITIES ON SALMON MEADOW AND ASH COVE:

Year	Control Activity	Acreage	Concentration	Efficacy	Effectiveness
2001	Herbicide, Diquat	17	1.5 gal/ acre Diquat	good	One season
2003	Herbicide , Diquat	17	1.5 gal/ acre Diquat	good	One season
2005	Herbicide, Diquat	17	1.5 gal/acre	good	One season

MILFOIL MANAGEMENT OPTIONS

The control practices used should be as specific to variable milfoil as feasible.

Exotic aquatic plant management relies on a combination of proven methods that control exotic plant infestations, including physical control, chemical control, biological controls (where they exist), and habitat manipulation. Integrated Pest Management Strategies (IPM) are typically implemented using Best Management Practices (BMPs) based on site-specific conditions so as to maximize the long-term effectiveness of control strategies. Descriptions for the control activities are closely modeled after those prescribed by the Aquatic Ecosystem Restoration Foundation (AERF) (2004). This publication can be found online at http://www.aquatics.org/aquatic_bmp.pdf.

Criteria for the selection of control techniques are presented in Appendix A. Appendix B includes a summary of the exotic aquatic plant control practices used by the State of New Hampshire. DES has evaluated the feasibility of potential control practices in Salmon Meadow and Ash Cove. The following table summarizes DES' control strategy recommendations for Salmon Meadow and Ash Cove.

FEASIBILITY EVALUATION FOR CONTROL ALTERNATIVES

Control Method	**Recommendation**
Restricted Use Areas	There is no situation that would benefit from the use of Restricted Use Area buoys in the waters near Krainwood Shores.
Hand-pulling	Hand-pulling of variable milfoil is recommended during the summer months to further reduce any variable milfoil that persists post-treatment, and if any new stems emerge.
Mechanical Harvesting/Removal	This control method not recommended due to shallow waters and underwater obstacles.
Benthic Barriers	Covering 20 acres of milfoil with benthic barriers is too large an area to be economically considered in this situation. Also, large boats may dislodge any barriers installed in shallow areas. Benthic barriers are recommended, however, in areas that are deemed suitable.
Herbicides	For Krainewood Shores, 2,4-D use is recommended as primary treatment in 2007 due to the extent of infestation and the desire for longer-term management and overall reduction in the percent cover of this plant.
Extended Drawdown	It would not be feasible or practical to lower Lake Winnipesaukee for milfoil control at this site.
Dredge	Dredging is not practical or economically feasible at this site. Dredging encourages the growth of exotic plants.
Biological Control	There are no approved biological controls for variable milfoil at this time in New Hampshire.
No Control	In order to allow for a healthy stand of mixed native aquatic vegetation, as well as areas of bare substrate in the shallows, a 'No Control' option is not

Control Method	Recommendation
	recommended. Without control, variable milfoil will eventually take over much of the waterfront in Ash and Salmon Meadow coves.

EXOTIC AQUATIC PLANT CONTROL PLAN

An evaluation of the size, location, and type of variable milfoil infestation, as well as the waterbody uses was conducted by DES on October 5, 2006. Based on the evaluation, the following control actions are recommended for Salmon Meadow and Ash Cove:

Year	Treatment Type	Responsible Party	Schedule
2007	2,4-D treatment of Areas 2-7 as indicated on Figure 1	Lycott Environmental, Inc.	May/June
	Weed Watcher Activities	Krainwood Shores Community Members	June through September
	Hand-removal/benthic barrier/suction harvesting of individual points indicated on Figure 1, and other applicable areas, to contain and/or remove any plants persisting post treatment	Krainwood Shores Community Members or contract divers	June through September
2008	Weed Watcher Activities	Krainwood Shores Community Members	June through September
	Hand-removal/benthic barrier/suction harvesting to contain and/or remove any plants persisting post treatment	Krainwood Shores Community Members or contract divers	June through September
2009	Weed Watcher Activities	Krainwood Shores Community Members	June through September
	Hand-removal/benthic barrier/suction harvesting to contain and/or remove any plants persisting post treatment	Krainwood Shores Community Members or contract divers	June through September
	Site assessment and plant mapping	DES	August/September
2010	2,4-D treatment of Areas 2-7 as indicated on Figure 1, if needed, and based on 2009 survey by DES	Licensed applicator	May/June
	Weed Watcher Activities	Krainwood Shores Community Members	June through September

Year	Treatment Type	Responsible Party	Schedule
	Hand-removal/benthic barrier/suction harvesting to contain and/or remove any plants persisting post treatment	Krainwood Shores Community Members or contract divers	June through September
2011	Weed Watcher Activities	Krainwood Shores Community Members	June through September
	Hand-removal/benthic barrier/suction harvesting to contain and/or remove any plants persisting post treatment	Krainwood Shores Community Members or contract divers	June through September
	Site assessment and plant mapping	DES	August/September
2012	Update and revise Long-Term Variable Milfoil Control Plan	NH DES, F&G, and interested parties	Spring 2012

The herbicide application will be targeted to the specific areas of milfoil growth shown in Figure 1. Only areas with milfoil growth will be targeted for control activities. Approximately 14% of this 135-acre area is slated for herbicide treatment, based on the locations of variable milfoil growth mapped in 2006.

CONSIDERATIONS FOR SELECTED MANAGEMENT PRACTICE

- Approximately 20 acres of this 135 acre cove will be impacted by the herbicide treatment (approximately 14% of the surface area of the coves). Targeted applications can be achieved by boat.

- The Department of Agriculture will impose standard short-term use restrictions for specified days depending on the use (irrigation, contact, etc) and the herbicide used. The shoreline will be posted and public notice will be made.

- By recommending follow-up management practices that utilize integrated plant management strategies such as benthic barrier placement and hand-pulling re-growth, variable milfoil re-growth or population expansion can be slowed.

- Ample native plant communities and open areas exist in both Salmon Meadow and Ash Cove, providing suitable fish and wildlife habitat (including loons) if the variable milfoil is controlled. Based on the native of the native plant community composition, it is not expected that native plants will be affected by a 2,4-D treatment.

Figure 1- Map of Milfoil Infestation in Salmon Meadow and Ash Cove

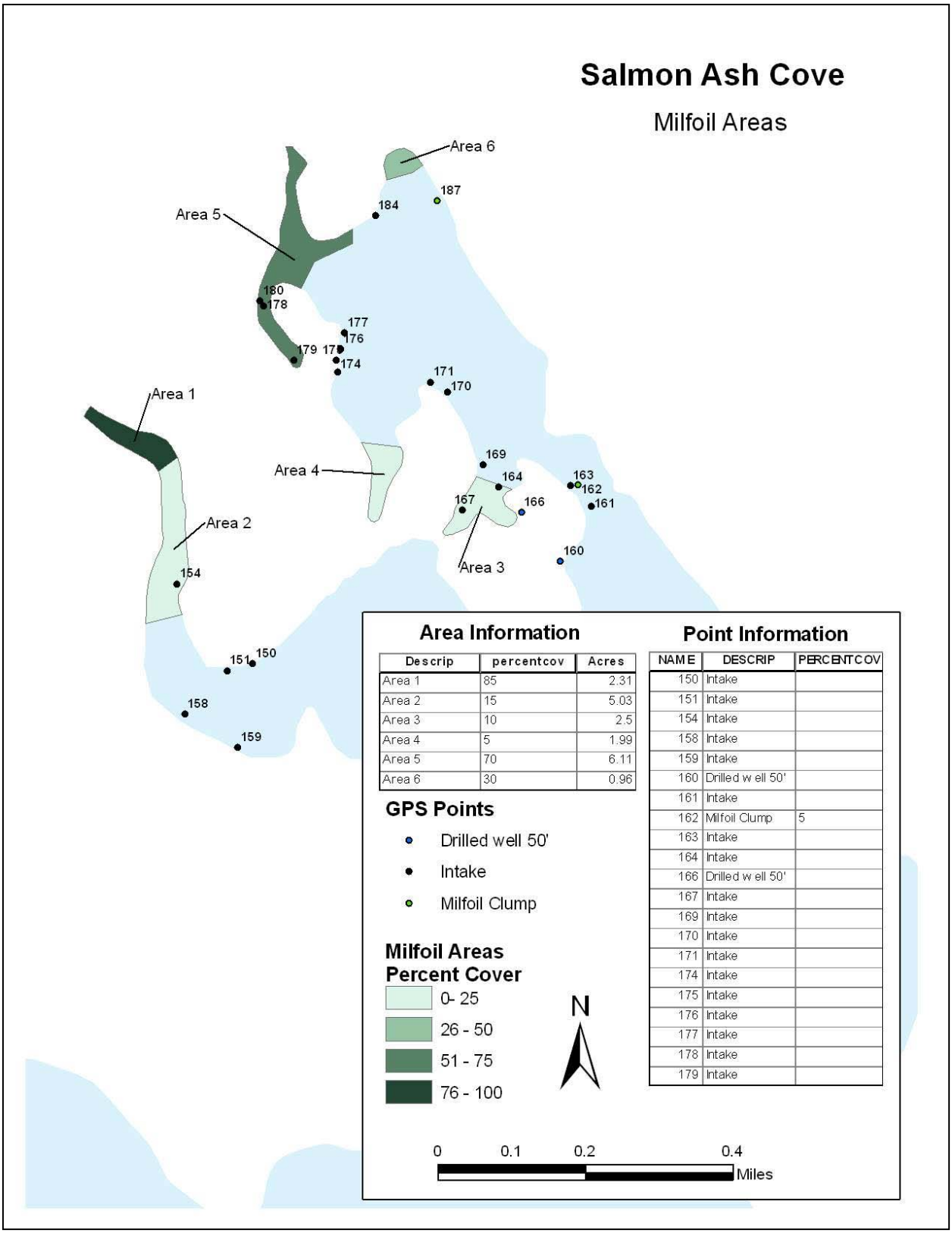
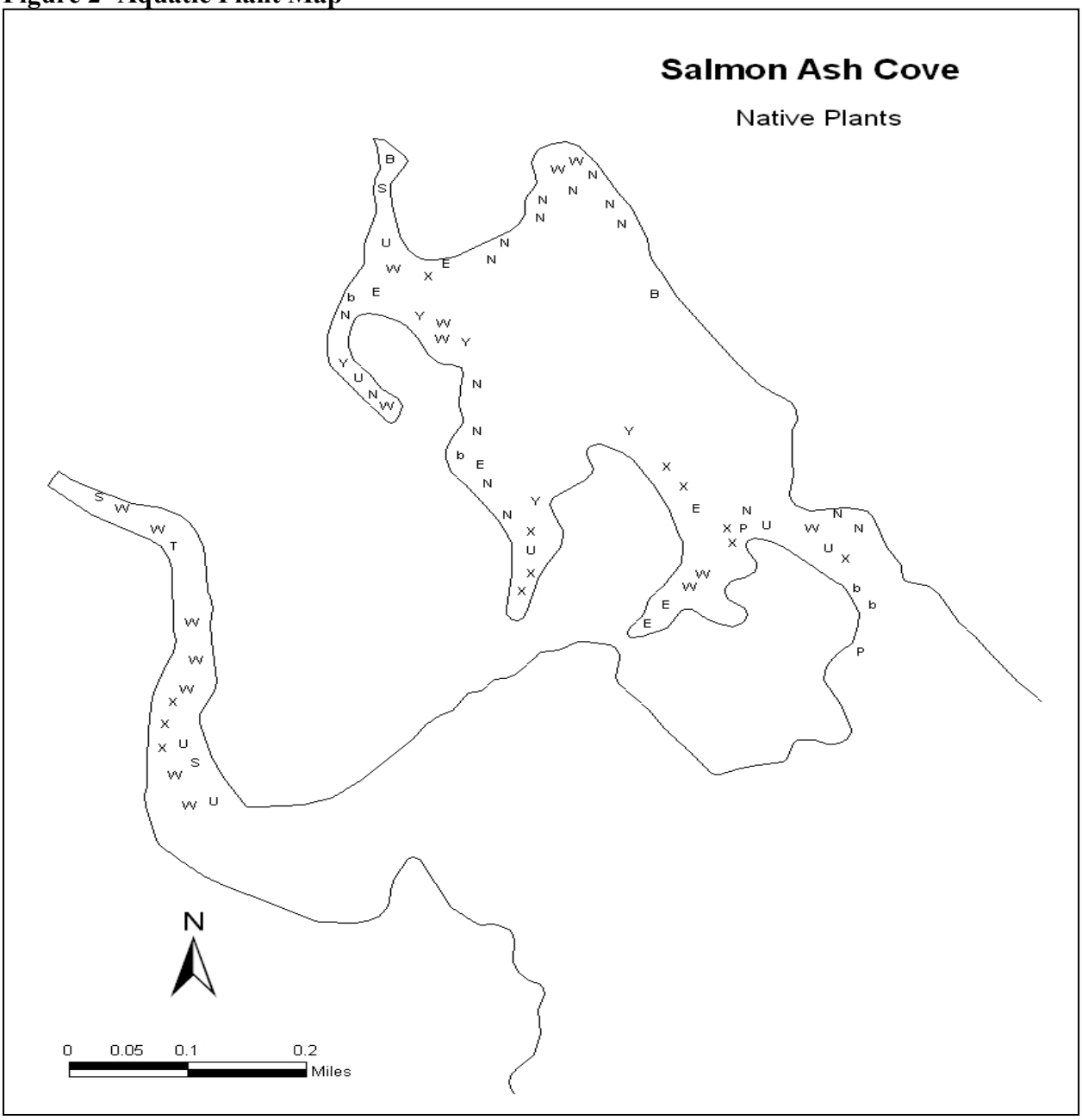

Salmon Ash Cove
Milfoil Areas
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
187
184
180
178
177
176
179
175
174
171
170
169
164
163
162
161
167
166
160
154
151
150
158
159
Area Information
Descrip | percentcov | Acres
Area 1 | 85 | 2.31
Area 2 | 15 | 5.03
Area 3 | 10 | 2.5
Area 4 | 5 | 1.99
Area 5 | 70 | 6.11
Area 6 | 30 | 0.96
Point Information
NAME | DESCRIP | PERCENTCOV
150 | Intake |
151 | Intake |
154 | Intake |
158 | Intake |
159 | Intake |
160 | Drilled w ell 50' |
161 | Intake |
162 | Milfoil Clump | 5
163 | Intake |
164 | Intake |
166 | Drilled w ell 50' |
167 | Intake |
169 | Intake |
170 | Intake |
171 | Intake |
174 | Intake |
175 | Intake |
176 | Intake |
177 | Intake |
178 | Intake |
179 | Intake |
GPS Points
Drilled well 50'
Intake
Milfoil Clump
Milfoil Areas
Percent Cover
0- 25
26 - 50
51 - 75
76 - 100
N
0
0.1
0.2
0.4
Miles

Figure 2- Aquatic Plant Map



Symbol	Common Name	Latin Name
M	Variable milfoil	*Myriophyllum heterophyllum*
W	Pondweed	*Potamogeton*
U	Bladderwort	*Utricularia*
T	Cattail	*Typha*
S	Bur-reed	*Sparganium*
b	Bulrush	*Scirpus*
t	Tapegrass	*Vallisneria*
E	Waterweed	*Elodea*
Y	Yellow water-lily	*Nuphar*
N	White water-lily	*Nymphaea*

Figure 3- Swim Platforms and Assumed Swim Areas

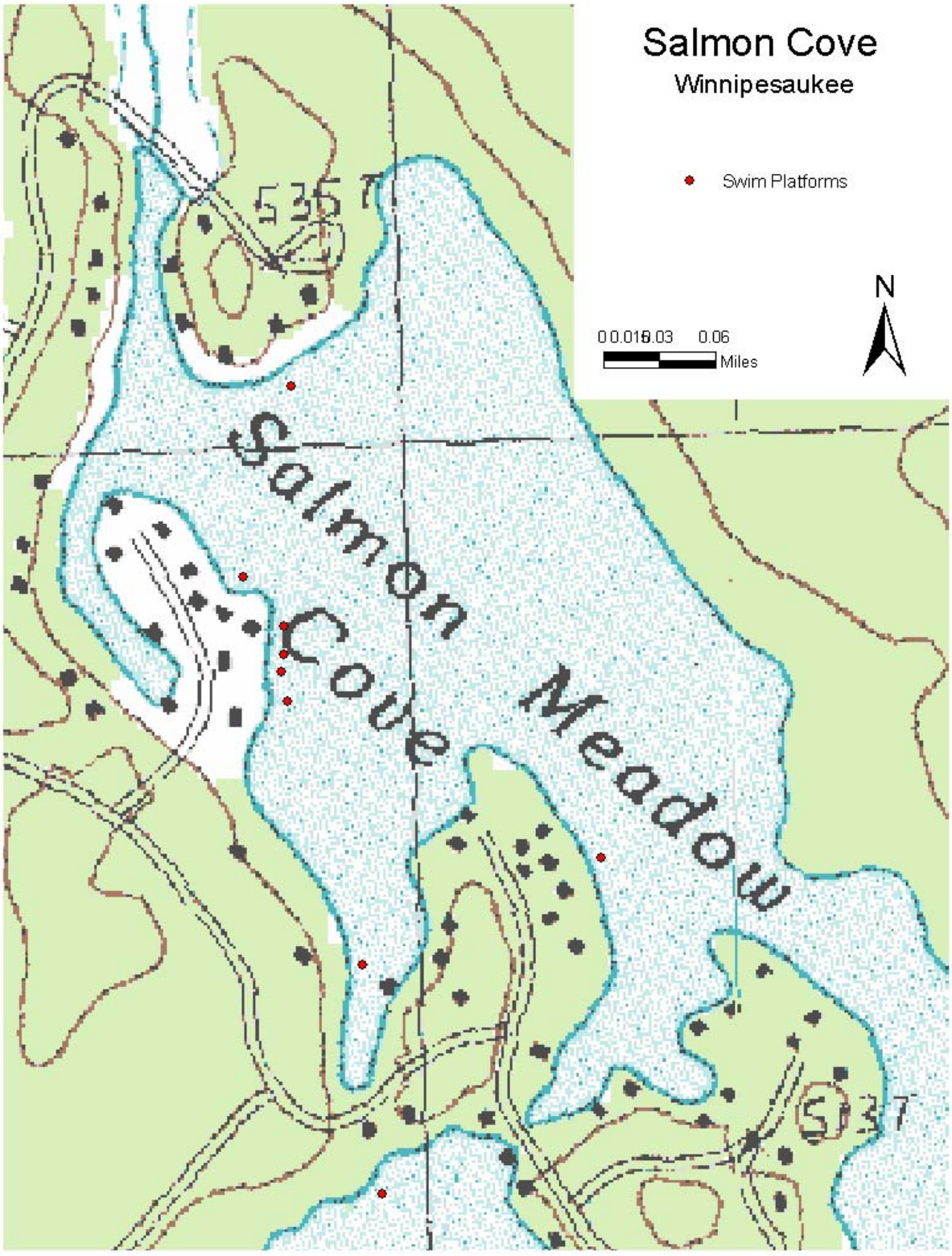


Figure 4- Common Boating Lanes

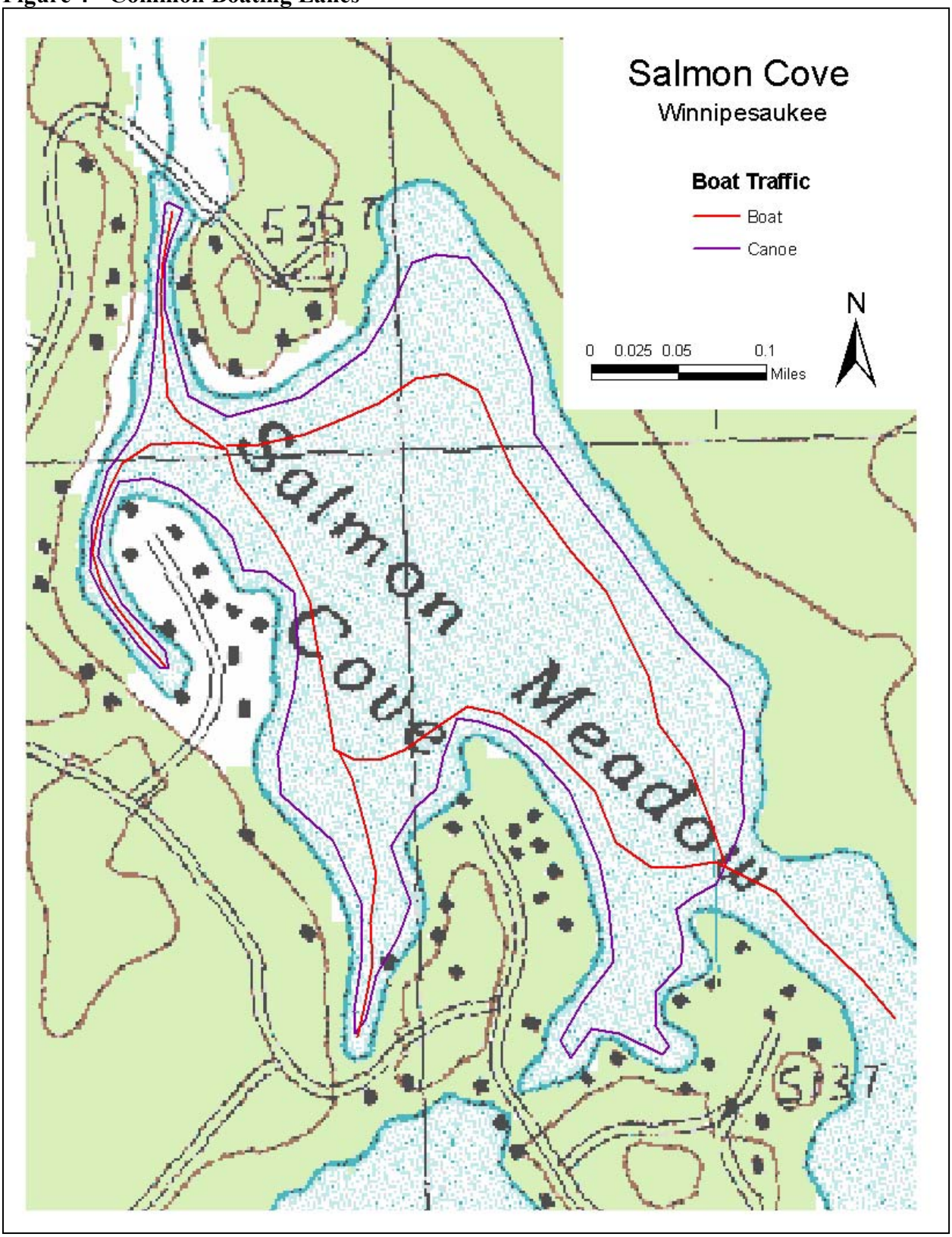
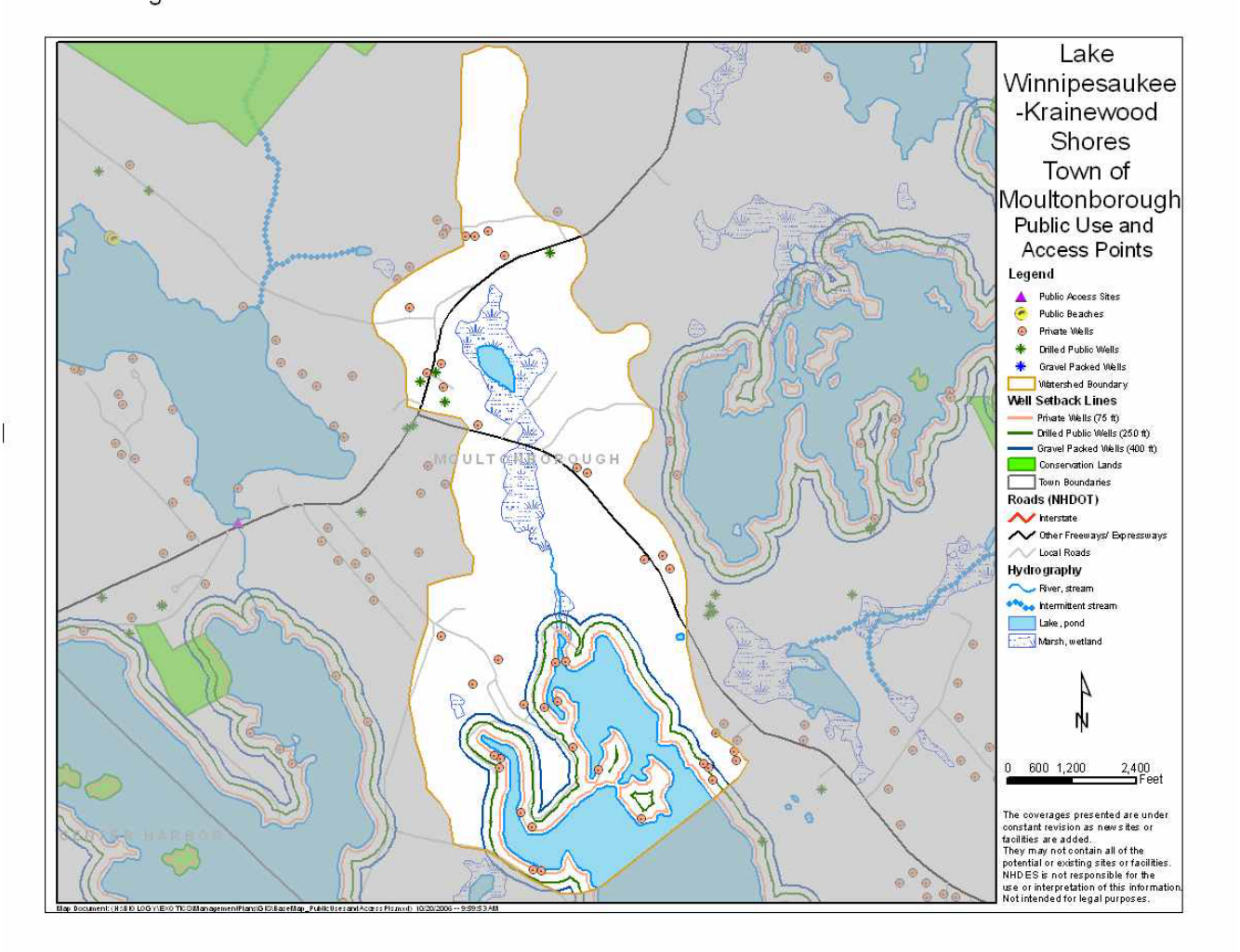


Figure 5- Public Uses and Setbacks



APPENDIX A

Criteria to Evaluate the Selection of Aquatic Plant Control Techniques
NH Department of Environmental Services
Water Division
Preliminary Investigations

I. Field Site Inspection

- Verify genus and species of the plant.
- Determine if the plant is a native or exotic species per RSA 487:16, II.
- Map extent of the plant infestation (area, water depth, height of the plant, density of the population).
- Document any native plant abundances and community structure around and dispersed within the exotic/nuisance plant population.

II. Office/Laboratory Research of Waterbody Characteristics

- Contact the appropriate agencies to determine the presence of rare or endangered species in the waterbody or its prime wetlands.
- Determine the basic relevant limnological characteristics of the waterbody (size, bathymetry, flushing rate, nutrient levels, trophic status, and type and extent of adjacent wetlands).
- Determine the potential impacts to downstream waterbodies based on limnological characteristics (water chemistry, quantity, quality).

Overall Control Options

For any given waterbody that has an infestation of exotic plants, one of three options will be selected, based on the status of the infestation, the available management options, and the technical knowledge of the DES Limnologists who have conducted the field work and who are preparing this plan. The options are as follows:

1) Eradication: Herbicide application targeted at exotic aquatic plant to be eradicated, to either eradicate the plant or to reduce overall biomass to a point where alternative non-chemical strategies may be used. This action will be followed by thorough annual monitoring for regrowth and the use of non-chemical actions to achieve the eradication.

2) Containment: The aim of this approach is to limit the size and extent of the existing infestation. An herbicide application may be used to reduce specified areas down to a percent cover of the exotic species so that it can be maintain or contained with alternative management strategies, including Restricted Use Areas, benthic barriers, and others. Subsequent herbicide applications may be necessary if the target species shows exponential growth and further spread.

3) No action. If the infestation is too large, spreading too quickly, and past management strategies have proven ineffective at controlling the target exotic aquatic plant, DES, in consultation with others, may elect to recommend 'no action' at a particular site. All efforts will instead be made towards containment of the target species to that specific waterbody, so that downstream migration of the plant can be prevented.

If eradication or control is the recommended option to pursue, the following series of control techniques may be employed. The most appropriate technique based on the determinations of the preliminary investigation will be selected.

Guidelines and requirements of each control practice are detailed below each alternative.

A. Hand-Pulling

- Can be used for exotic or native species.
- Can be used if infestation is in a small localized area (sparsely populated patch of up to 5' X 5', single stems, or dense small patch up to 2' X 2').
- Can be used if plant density is low, or if target plant is scattered and not dense.
- Can be used if the plant could effectively be managed or eradicated by hand-pulling a few scattered plants.
- Use must be in compliance with the Wetlands Bureau rules.

B. Mechanically Harvest or Hydro-Rake

- Can not be used on plants which reproduce vegetatively by fragmentation (e.g., milfoil, fanwort, etc.) unless containment can be ensured.
- Can be used only if the waterbody is accessible to machinery.
- Can be used if there is a disposal location available for harvested plant materials.
- Can be used if plant depth is conducive to harvesting capabilities (~ <7 ft. for mower, ~ <12 ft. for hydro-rake).
- Funds are available for repeated harvesting activities in that season.
- A navigation channel is required through dense plant growth.

C. Chemical Treatment

- Can be used if application of chemical is conducted in areas where alternative control techniques are not optimum due to depth, current, use, or type of plant.
- Can be used for treatment of exotic plants where fragmentation is a high concern.
- Can be used where species specific treatment is necessary due to the need to manage other plants (rare or endangered that will not be impacted by chemical treatment).
- Can be used if other methods used as first choices in the past have not been effective.
- A licensed applicator should be contacted to inspect the site and make recommendations about the effectiveness of chemical treatment as compared with

other treatments.

D. Restricted Use Areas (per RSA 487:17, II (d))

- Can be used for exotic species only.
- Can be established in an area that effectively restricts use to a small cove, bay, or other such area where navigation, fishing, and other activities may cause fragmentation to occur.
- Can not be used when there are several "patches" of an infestation of exotic aquatic plants throughout a waterbody.
- Can be used as a temporary means of control.

E. Bottom Barrier

- Can be used for exotic or native species.
- Can be used in small areas, preferably less than 10,000 sq. ft.
- Can be used in an area where the current is not likely to cause the displacement of the barrier.
- Can be used early in the season before the plant reaches the surface of the water.
- Can be used in an area to compress plants to allow for clear passage of boat traffic.
- Can be used in an area to compress plants to allow for a clear swimming area.

F. Drawdown

- Can be used if the target plant(s) are susceptible to drawdown control.
- Can be used in an area where bathymetry of the waterbody would be conducive to an adequate level of drawdown to control plant growth, but where extensive deep habits exist for the maintenance of aquatic life such as fish and amphibians.
- Can be used where plants are growing exclusively in shallow waters where a drawdown would leave this area "in the dry" for a suitable period of time (over winter months) to control plant growth.
- Can be used in winter months to avoid encroachment of terrestrial plants into the aquatic system.
- Can be used if it will not significantly impact adjacent or downstream wetland habitats.
- Can be used if spring recharge is sufficient to refill the lake in the spring.
- Can be used in an area where shallow wells would not be significantly impacted.
- Reference RSA211:11 with regards to drawdown statutes.

G. Dredge

- Can be used in conjunction with a scheduled drawdown.
- Can be used if a drawdown is not scheduled, though a hydraulic pumping dredge should be used.

- Can only be used as a last alternative due to the detrimental impacts to environmental and aesthetic values of the waterbody.

H. Biological Control

- Grass carp cannot be used.
- Exotic controls, such as insects, cannot be introduced to control a nuisance plant.
- Research should be conducted on a potential biological control prior to use to determine the extent of host specificity.

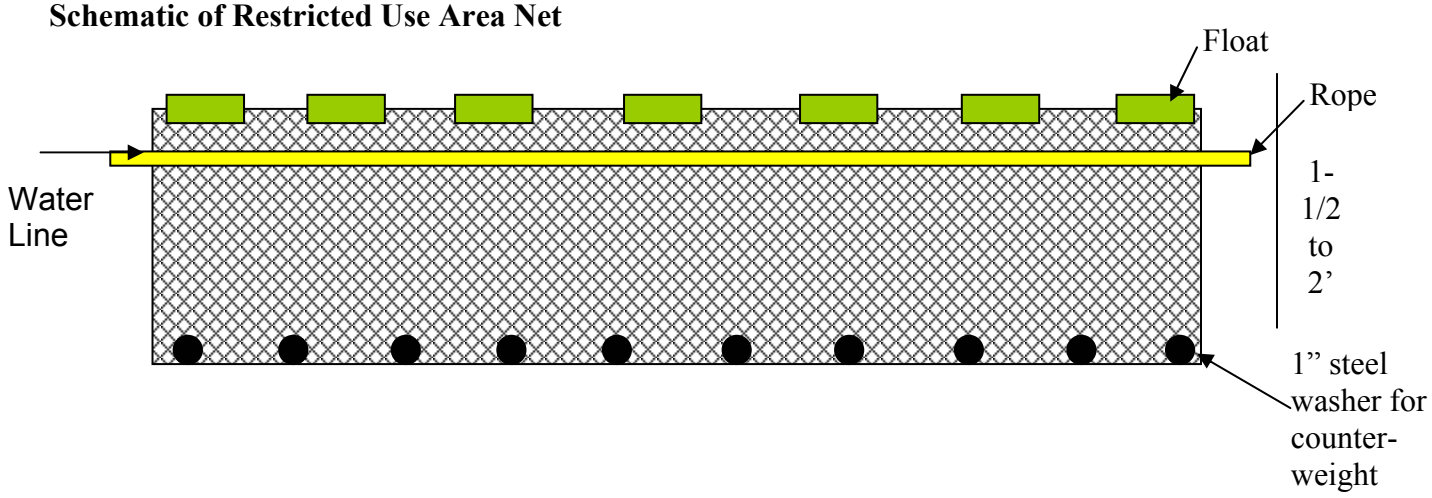
APPENDIX B

SUMMARY OF CONTROL PRACTICES USED IN THE STATE OF NEW HAMPSHIRE FOR EXOTIC AQUATIC PLANTS

Restricted Use Areas:

Restricted Use Areas (RUAs) are a regular control option for lakes with small, contained infestations of exotic plants, limited to small patches or embayments. This is often the case in waterbodies with newly-discovered infestations. RUAs restrict access to all recreational activities in a delineated area to minimize plant fragmentation and thereby reduce the spread of milfoil. As an additional method of protection from fragment migration, RUAs are encircled with a shallow net that is suspended vertically in the water column. The net is approximately 1.5-2.0 feet in height. The top of the net is set to extend four inches above the surface of the water, while the remainder is positioned below the surface of the water (see figure below). This configuration prevents the movement of fragments from infested areas to uninfested areas. Due to the size and nature of net construction, there is no impediment to fish migratory patterns or spawning activities.

Schematic of Restricted Use Area Net



Hand-pulling:

When infestations of exotic aquatic plants begin as single scattered stems or small patches, DES biologists SCUBA dive to hand-pull the plants (and DES can train other certified divers to also perform this management practice). Guidelines for determining feasibility and effective for hand-removal are site specific, but generally sparsely populated patches of up to 5' X 5', single stems, or dense small patch up to 2' X 2' are reasonable.

The whole plant including the roots should be removed in this process, while leaving the beneficial native species intact. This technique works best in softer sediments, with shallow rooted species and for smaller, scattered infestation areas. When hand pulling nuisance species, the entire root system and all fragments of the plants must be collected since small root or stem fragments could result in additional growth of the species. The process must be repeated often to control re-growth of the exotic plants. For a new infestation, hand-pulling activities are typically conducted several times during the first season, with follow-up inspections for the next 2-5 years

or until no re-growth is observed. This control practice has proven successful in many waterbodies.

Mechanical Harvesting

The process of mechanical harvesting is conducted by using machines which cut and collect aquatic plants. These machines can cut the plants up to twelve feet below the water surface. The weeds are cut and then collected by the harvester or other separate conveyer-belt driven device where they are stored in the harvester or barge, and then transferred to an upland site.

The advantages of this type of weed control are that cutting and harvesting immediately opens an area such as boat lanes, and it removes the upper portion of the plants. Due to the size of the equipment, mechanical harvesting is limited to water areas of sufficient size and depth. It is important to remember that mechanical harvesting can leave plant fragments in the water, which if not collected, may spread the plant to new areas. Additionally harvesters may impact fish and insect populations in the area by removing them in harvested material. Cutting plant stems too close to the bottom can result in re-suspension of bottom sediments and nutrients. This management option is only recommended when nearly the entire waterbody is infested, and harvesting is needed to open navigation channels through the infested areas.

Benthic Barriers:

When a small infestation of exotic aquatic plants occurs in clusters of growth (generally areas >5 ft^2), as opposed to scattered stems, a permeable fiberglass screen can be placed over the area of infested lake sediments. The permeable fabric screening allows for gas release from the sediments while effectively blocking sunlight and compressing the plants into the sediment, inhibiting photosynthesis and eventually killing the plant. Occasionally, in some lakes, gas release from the sediments or boating activity cause the uplifting of screening. Benthic barriers can effectively control small infestations of less than approximately 10,000 square feet.

Benthic barriers have two basic applications. These practices are used to cover pioneering infestations and prevent the spread of the plant. Bottom barriers are installed across small portions of lake bottoms infested with invasive aquatic plants. The disadvantage of benthic barriers is their non-selectivity and limitation of cover to less than 10,000 square feet. Additionally, these physical barriers prevent the growth of all vegetation, which is a necessary component of fish and wildlife habitat.

Bottom barriers are attached to the bottom of a water body by re-bar attached to the edges and across the middle of the material. Bottom barriers are transported to the shoreline adjacent to where installation is to occur. They are then cut to fit the treatment site and rolled onto a length of pipe. Divers carry the roll into the water at the start of the treatment site and secure one edge of the material to the lake bottom. The divers then roll out the remainder of the material and continue to secure it to the bottom sediments. This process is repeated until the plants in the treatment are covered.

Bottom barriers are generally considered for small localized areas rather than lakewide application. Bottom barriers provide 100% control of this weed in areas where they are installed. They also provide long-term control. An ongoing maintenance operation is required to inspect the bottom barrier and clear the mats of sediment buildup.

Benthic barriers are not recommended for application in river systems, as flow can easily uplift the barrier.

Targeted Application of Herbicides:

The use of chemicals, such as herbicides, for the control of noxious and nuisance plant species represents one of the most widely known and effective management options available. Herbicide control of invasive aquatic plants is often the first step in a long-term integrated control program. In the last 15 to 20 years the use and review of herbicides has changed significantly in order to accommodate safety, health, and environmental concerns. Currently no herbicide product can be labeled for aquatic use if it has more than a one in a million chance of causing significant harmful effects to human health, wildlife, or the environment. Because of this, the number of effective and U.S. Environmental Protection Agency (EPA) approved herbicides for aquatic weeds are limited. In most cases the cost and time of testing and registration, rather than environmental issues, limits the number of potentially effective compounds.

All herbicide applications in New Hampshire are performed under permits issued by the New Hampshire Department of Agriculture, Division of Markets and Food, Bureau of Pesticide Control.

Two herbicides have been used in New Hampshire for the control of milfoil. Diquat (trade name Reward), the most often-used herbicide, is a contact herbicide that can generally provide one season of control for milfoil. Because this herbicide does not target the root systems, the plants eventually re-grow from established roots.

The second herbicide, 2, 4-D (trade name Navigate or Aqua Kleen), is a systemic herbicide. It is absorbed into the sediments and taken up through the root system, killing both the roots and the plant biomass above the sediments. Label restrictions for aquatic application currently limit its use in New Hampshire to waterbodies with no water intakes, and with no wells adjacent to the shoreline.

The aquatic herbicide SONAR has been used in New Hampshire to control growths of fanwort. The chemical acts by limiting photosynthesis when chlorophyll-a is affected by the active ingredient of the herbicide.

Extended Drawdown

Water drawdown is used for control of some species of aquatic macrophytes. Drawdown requires some type of mechanism to lower water levels, such as dams or water control structures and use is thus limited. It is most effective when the drawdown depth exceeds the depth or invasion level of the target plant species.

In northern areas, drawdown will result in plant and root freezing during the winter for an added degree of control. Drawdown is typically inexpensive and has intermediate effects (2 or more years). However, drawdown can have other environmental effects and interfere with other functions of the water body (e.g. drinking water, recreation, or aesthetics). Drawdown can result in the rapid spread of highly opportunistic annual weed species, which in most cases is the plant that is targeted for control.

Drawdowns have been used in the past for plant control. In theory, the drying of the plants in the summer, or the freezing of the plants in the winter, will eliminate or limit plant growth. However, milfoil often forms a more succulent terrestrial form during drawdown conditions and the succulent form of the plant can remain viable for long periods of time without submergence, making the practice ineffective. This strategy can be used for control of some native plant species.

Dredging

Dredging is a means of physical removal of aquatic plants from the bottom sediments using a floating or land-based dredge. Dredging can create a variety of depth gradients creating multiple plant environments allowing for greater diversity in lakes plant, fish, and wildlife communities. However due to the cost, potential environmental effects, and the problem of sediment disposal, dredging is rarely used for control of aquatic vegetation alone.

Dredging can take place in to fashion, including drawdown followed by mechanical dredging using an excavator, or using a diver-operated suction dredge while the water level remains up.

Biological Control

There are no approved biological controls for submersed exotic aquatic plant at this time in New Hampshire.

REFERENCES

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